

SOME ŒNOTHERAS FROM CHESHIRE AND LANCASHIRE¹

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OBSERVATIONS

Œnotheras are known to have been naturalized on the Lancashire coast since 1805, and probably existed there much earlier. They are now found on the sand dunes in many places, from Liverpool and the vicinity of Birkenhead northwards along the coast to Southport and Blackpool. They are notably abundant at St. Anne's-on-Sea, where they have been described by Bailey ('07), and in certain localities near Birkenhead (MacDougal '07). I have grown, chiefly at the Missouri Botanical Garden, extensive cultures of plants from the latter region, from seeds obtained through Dr. D. T. MacDougal in 1907, and have visited the Lancashire coast in 1910 and again in July, 1914, when I travelled along the coast from Liverpool to Southport and from Blackpool to St. Anne's. The œnotheras everywhere appear to be spreading, although children gather the flowering shoots in armfuls. The profusion of individuals is greatest at St. Anne's, where acres of waste land in the town are dotted over with them. Smaller colonies occur in various other places, notably at Bidston Junction, near Hightown and at Formby. Small groups of half a dozen plants are sometimes found in isolated places on the dunes.

I will first refer to some of these colonies as I saw them during my last visit, and will then describe a few of the many forms observed in cultures.

The Bidston Junction colony, referred to in MacDougal ('07), is a compact and almost uniform one occurring on a triangular piece of ground between railway tracks, about five minutes' walk down the foot path from Bidston Junction towards Wallersy, on the right-hand side. Some years ago, quantities of sand were dumped here from the coast between Wallersy and New Brighton. Soil from neighboring gardens has also been

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deposited here, and the advent of the *œnotheras* is doubtless from one or other of these two sources.

The plants closely resemble the "Isle of Wight" race of *Æ. Lamarckiana* (to be described in a book now in process of publication) and the species as it generally appears in English gardens. The rosettes in this colony differ in having green midribs (both dorsally and ventrally), or pink midribs (both dorsally and ventrally), but the depth of red varies. The same applies to the stem-leaves. This is curiously different from other races, such as *Æ. mut. rubrinervis*, in which the midribs are red dorsally and green ventrally. The rosette leaves are usually nearly or quite smooth, but some may be crinkled. The plants were short, their average height being about twenty-two inches, though some reached a height of over three feet. The stems bear many red papillæ. The smaller plants were unbranched, the lower stem-leaves being closely crinkled and curled while the upper leaves and bracts are often quite smooth. A peculiarity of the race was the irregular disposition on the stem of much-crinkled and nearly smooth leaves, without gradual transitions between them such as usually occur in de Vries's race of *Æ. Lamarckiana*. Not infrequently crinkled and smooth leaves alternate. The buds have fewer long hairs than in the above mentioned race, and the sepals have uniformly the red color pattern 5-7 of *Æ. mut. rubrinervis*, though they vary somewhat in depth of shade. The dimensions of the flowers were as follows: bud cone 50 mm., hypanthium 43 mm., ovary 11 mm., diameter of cone at base 11 mm., length of petals 50 mm., width 60 mm. One plant was identical with the race of de Vries, except in its larger flowers, reddish sepals and fewer long hairs. In most plants there is also a strong distinction between the smooth and crinkled leaves.

This colony differs, therefore, in minor peculiarities from any race of *Æ. Lamarckiana* previously observed, and it exhibits a relatively narrow range of variation.

Along the electric railway tracks north of Liverpool, between Crosby and Hightown, an equally extensive and uniform colony of *Æ. biennis* was found. Thousands of plants, in flower and rosettes, were growing on uncultivated land with a nearly pure sandy soil, behind the coast range of sand hills in a long narrow

area near a clump of small poplar trees. Near the upper end of this area the plants differed in having smaller flowers (petals 21 mm.) and narrow leaves (20 mm. broad). The remainder of the plants had somewhat larger flowers (petals usually 25–27 mm. long), and broader leaves (extreme width 50 mm.).¹ This was almost the only variation observed, and the race comes very close to the type of *Œ. biennis* L. The dimensions of the buds were as follows: bud cone 20 mm., hypanthium 25 mm., ovary 11 mm., anthers surrounding the stigma. The rosette-leaves and stem-leaves *all* have red midribs both dorsally and ventrally. On the same stem some leaves are smooth and some more or less crinkled. The buds are green, devoid of red, with some long hairs, and there are no red papillæ on any part of the plant. Some of the larger plants are well-branched and with very stout stems, a huge pith and a very narrow ring of wood.

This colony is even more uniform than the previous one, and must have originated from one or a very few plants.

Small colonies of *Œ. biennis* were seen at Formby, near the station and in other places. A race of *Œ. Lamarckiana* also grows here on the dunes, although I did not succeed in finding the spot, but local gardens cultivate it. The species is depicted, however, in a rose window erected in St. Luke's Church, Formby, in 1898, containing representative plants of the local flora. The central portion of the window is divided hexagonally and in the six sections the evening primrose alternates with the sea holly. The foliage and large flowers of the former are distinctly shown. Around the margin of the window are *Pyrola rotundifolia* and irises.

At Blundell Sands, near Crosby, a small colony of *Œ. Lamarckiana* was seen on waste ground, and again on the extensive sand dunes between Birkdale and Ainsdale, near Southport. In the latter case there were only three plants, and these possessed red sepals, color pattern 7, green midribs, crinkled leaves, and about $\frac{n}{4}$ long hairs.

By far the greatest abundance of plants was found at St.

¹ These apparently correspond to *Lysimachia virginiana altera, foliis latioribus, floribus luteis majoribus*, Cat. Altdorff. See Gates, R. R. The mutation factor in evolution [pp. 61, 65, 70]. Macmillan. London.

Anne's. In addition to those in the town, which are in great profusion, numerous smaller colonies are scattered along the adjacent sand dunes. The great majority of the plants is the same as at Bidston Junction except in the crinkling of the leaves, having foliage closely resembling that of de Vries's *Æ. Lamarckiana*, midribs red both above and below, the red absent in some individuals. The flower measurements were, length of petals 50 mm., hypanthium 45 mm., ovary 10 mm. Several aberrant individuals were also observed. One dwarf mutant was found growing in the shade of a large plant. It resembled *Æ. mut. nanella* but had red midribs. One large rosette, having leaves very obtuse and pale pink midribs, probably belonged to *Æ. mut. brevistylis*. A number of plants represented a shorter spindling type with very narrow rosette-leaves (18 mm. wide x 14 cm. long). Another plant belonged to a new type, large and branching with thicker, narrower leaves (33 mm. x 13 cm.), stiffer and narrowly pointed, midribs white, and later in beginning to flower (buds only half developed, July 16).

In addition to these probable mutants, there were found in one field a few plants of a small-flowered *Æ. biennis* race growing with the *Æ. Lamarckiana*. They differed from the latter only in the small flowers (petals 22 mm., style short), and hence were unlike the *Æ. biennis* race previously described. Near by were also found plants, evidently hybrids of these two races, with petals about 30 mm. in length.

CULTURES

Some of my cultures of *œnotheras* from near Birkenhead have already been described in a general way (Gates, '13). Here I wish to describe a few of these forms in detail, and also to refer to my experiments with plants from St. Anne's. I have not seen the colony from which the Birkenhead seeds were obtained, but it evidently contains a great profusion of forms belonging to both *Æ. Lamarckiana* and *Æ. grandiflora*, while all the colonies I have observed have a much more uniform population.

Æ. MULTIFLORA

One of the distinct races in these cultures I have already (Gates, '10) referred to as *Æ. multiflora*. It is descended

entirely from one individual from a sowing of Birkenhead seeds at Woods Hole in 1908. From this individual an F_1 of 376 plants was grown in the two following years. About 4 per cent of these plants showed virescence, as described in the above paper. In 1910 a total of 297 plants were grown, most of which belonged to the F_2 . An F_3 numbering 193 plants in nine families was grown in 1911, and an F_4 of 356 plants in eight families in 1912. The plants were by no means uniform, and they varied considerably from year to year. The description given is therefore a generalized one, and the condition of variability is no doubt similar to that of many wild "species." By isolating the offspring of a larger number of individuals, no doubt this variation could have been further analyzed, but more pressing problems have prevented this being done.

Plate 20 fig. 1 shows a typical rosette of my 1909 culture, pl. 20 fig. 3 the full-grown plant, and pl. 20 fig. 6 a flowering shoot on a larger scale. Specimens of this species are preserved in the herbarium of the Missouri Botanical Garden from my cultures of 1909, and in the British Museum (Natural History) from the 1912 families.

Description: Rosette of few leaves, broad and obtuse-pointed, somewhat crinkled. Full-grown plant pyramidal in outline, with lateral branches and persisting rosette leaves. Average height about 88 cm. Stems slender, stem-leaves smooth, lanceolate, bracts broadly cuneate at base with a very short petiole, tip long-pointed, more or less curled, margin irregularly repand-denticulate. Inflorescence compact, flowers numerous; buds squarish, slender with very long and slender sepal tips, sepals thin, bud cone 35 mm. long, hypanthium 37 mm., sepal tips 7 mm., ovary 10 mm., petals 43 mm., very broad and overlapping when flower is open, long hairs fairly numerous. Few red papillæ on main stem, many on side branches. In 1909 culture the buds were all green, but in 1911 they had the red color pattern of *Œ. mut. rubrinervis* and the stems were also reddish.

As regards variations, virescence appeared in the first two generations but not in the last two. On the other hand, a var. *elliptica* was first observed in F_2 and further studied in F_3 and F_4 . This variety differs essentially in being smaller and having narrower leaves and narrow, more or less elliptical petals. Plate

20 fig. 2 shows a rosette of this variety in F_3 (1911). One family of 50 plants in 1910 contained 5 of this variety. Usually these plants show partial variability, some flowers having broad petals and others narrow and elliptical ones. Even the different petals of the same flower may show these differences. Flowers with elliptical petals are invariably smaller and are frequently found on the side branches when those of the central stem have normal petals. Hence this variation may be a matter of strength in the plant. The variation, from petals which are broad and truncate or emarginate to those which are narrow and elliptical, or even almost cruciate, is continuous. Thus on one plant in 1911, the dimensions of the petals in two flowers were as follows:

- Flower 1. Petal (1) 31 mm. x 21 mm.
- Petal (2) 25 mm. x 17 mm.
- Petal (3) 20 mm. x 12 mm.
- Petal (4) 22 mm. x 13 mm.

In this flower the petals are very small and very unequal in size but all elliptical.

- Flower 2. Petal (1) 38 mm. x 39 mm.
- Petal (2) 37 mm. x 37 mm.
- Petal (3) 34 mm. x 36 mm.
- Petal (4) 35 mm. x 36 mm.

In this flower the petals were nearly full size, nearly equal, and scarcely elliptical.

The inheritance of this condition is on a sliding scale, plants with only broad petals giving some offspring with elliptical petals, and plants with elliptical petals giving some offspring having only broad petals, though in the latter case the plants bearing elliptical petals are more numerous than in the former case. Thus the F_3 family from a normal plant contained 14 specimens having broad petals only and 15 having some elliptical petals; while another F_3 family of 44 plants derived from a plant having elliptical petals contained only 5 plants having exclusively broad petals. These peculiarities of the petals are probably to a large extent under the control of environmental features such as temperature and water supply.

The difference between broad and narrow leaves is much sharper. Thus in my F_4 cultures in 1912 certain families contain

both the broad or normal type (pl. 20 fig. 5) and the *elliptica* variety (pl. 20 fig. 4). The latter had a number of flowers with elliptical petals and it also had a different method of branching. Plate 21 fig. 12 is representative of a uniform F₄ culture of 49 plants of the variety *elliptica*. This photograph is taken on a larger scale, and the nodding of the stem is merely due to wilting. This differs from *typica* (pl. 20 fig. 5) constantly in having narrower leaves and short branches, as well as in the occasional elliptical flowers which appear to be largely under environmental control.

The variability of this race is therefore as interesting as are the features, such as the general bud and leaf characters, in which it is constant. The fact should also be mentioned that a *lata*-like mutant, doubtless having 15 chromosomes, appeared in the F₄ generation, and also a mutant resembling *Æ. mut. albida*.

Æ. RUBRINERVOIDES

This race resembles *Æ. mut. rubrinervis* in many features, and yet differs from it constantly throughout. I have previously referred to this Birkenhead race as No. 25 (Gates, '11, p. 350) and studied the variation of the red stripes on the buds. In all, 1968 plants of this race have been grown in the years 1909–1912, so that four generations of offspring from a single individual have been cultivated. An illustration of that individual has already been published (Gates, '12, pl. 3). One family of offspring was grown in 1909, two in 1910, eight in 1911 and nine in 1912. Usually the variability of families progressively decreased, since each family was derived from the selfing of one individual of the previous generation. The discussion of the precise ancestry of this race is of course out of the question, but its characters bear nearly though not quite the same relation to the *Æ. Lamarckiana* from this region that the *Lamarckiana* and *rubrinervis* of de Vries's cultures bear to each other.

The 1909 family, or F₁, numbered 111 plants. Plate 21 fig. 8 shows one of these as a rosette. The leaves are narrower and more pointed than in *mut. rubrinervis*, and nearly smooth. About 20 of the plants in this culture omitted the rosette stage altogether and shot up a stem directly from the seedling stage (pl. 20 fig. 7). A normal mature plant of this family is shown

in pl. 21 fig. 11. It will be seen that there is no indication of a rosette, and the branching is quite different from that of *Æ. mut. rubrinervis*. In many cases, however, a rosette is formed. When the rosette is omitted the branching is changed. Plate 21 fig. 10 shows on a larger scale another individual in flower. The stem-leaves differ from those of *Æ. mut. rubrinervis* in being narrower, more pointed and smoother.

In this race the red papillæ on the stem were very numerous, and the buds likewise were slightly more red than in *Æ. mut. rubrinervis*. The modal color pattern of the whole population was 5 as in *Æ. mut. rubrinervis*, but plants with their mode at 7 were much more numerous than in the latter (see Gates, '11, p. 351). The race as a whole inherited the capacity for producing a slightly greater amount of pigment. The ovary usually bore many long hairs arising from red papillæ; on the hypanthium were few long hairs from slight green mounds; and on the bud cone scattered long hairs from conspicuous red papillæ. In occasional buds, when the color pattern was only 3, the green papillæ were more numerous. In addition to the color pattern of the sepals there was usually weak red on the hypanthium.¹

The same conditions as regards pigmentation have been maintained in later generations. The plants were, however, by no means uniform in all respects, and this was not to be expected since they were derived from one individual of a freely intercrossing population. Plate 21 fig. 9 represents a rosette of one of the F₂ plants. The latter differs obviously from the one represented in pl. 21 fig. 8, but the race retained in this and subsequent generations the long, narrow, smoothish leaves as well as the pigmentation. The various F₃ and F₄ families, each derived from a selfed individual, produced sub-races differing more or less from each other and varying within narrower limits. It does not appear that the Mendelian theory of the sorting out of factors, or "genes," affords an adequate explanation of all these phenomena.

¹Since this condition of bud-pigmentation resembles that obtained in certain F₂ and F₃ hybrids of *Æ. mut. rubricalyx* and *Æ. grandiflora* (see Gates '14), it is possible that it may have arisen in a similar way, i. e., by the appearance of a red-budded mutation which subsequently crossed with other species, in which crosses some blending of pigmentation occurred giving rise to the present condition.

Œ. TARDIFLORA

This name I have used for another race having many peculiarities and showing more resemblance to *Œ. grandiflora* in its flowers and foliage. It is race No. 52 from the same source as the above. A single individual produced in 1909 nineteen plants which were fairly uniform. The rosettes contained only a few leaves, but large plants were formed, one of which is shown in pl. 22 fig. 17. Although this photograph was taken on August 21, the plants with one exception had not begun to flower. The leaves resembled those of *Œ. grandiflora*. They were large with long and acute tips, tapering to the bases, often bearing reddish blotches, sometimes much curled, somewhat crinkled along the midrib. The margin was conspicuously serrately toothed (see pl. 22 fig. 17). At the end of the season (September) these plants came into bloom, and pl. 22 fig. 20 shows a plant photographed on October 2. The buds resembled those of *Œ. grandiflora* but were small. The bud cones were pointed, smooth and rounded, the petals slightly larger than in *Œ. bien-nis*, or in a few cases much larger. The petals were also deeply emarginate, strongly cuneate and narrow; and the bracts were very small, narrowly lanceolate and yellowish, giving a peculiar appearance to the flowering shoot. The margins of the bracts were nearly entire or in some cases distantly denticulate.

The offspring of the plant in pl. 22 fig. 20 were grown and showed the same peculiarities. The race has not been cultivated further. It was doubtless of hybrid origin and was more nearly allied to *Œ. grandiflora* than to the *Lamarckiana* complex.

Œ. RUBRITINCTA

Reference may be made to one further race which was known as "type m." It originated from one plant in a sowing of the Birkenhead seeds in 1909. It will be understood that scarcely two plants from this sowing were alike, but some were much more distinct than others. The plant in question was a handsome one with very narrow leaves and bright red midribs. Its offspring, grown in 1911, were lost with the exception of one plant which was the same as the parent. It is shown in pl. 22 fig. 16. The basal leaves were very long with long petioles, the stem leaves very narrow, smooth, with margin closely repand-

denticulate, blade narrowing gradually to a very short petiole, midribs and petioles bright red dorsally and ventrally; lowermost bracts 17 mm. in width by 9 cm. in length, upper bracts 11 mm. wide by 58 mm. in length. The buds most resemble those of *Æ. grandiflora*, being nearly devoid of long hairs, slender and somewhat rounded, with setaceous sepal tips and some red on the sepals; length of petals 32 mm., hypanthium 43 mm., sepal tips 9 mm., ovary 10 mm.

In 1912 three families of F_2 offspring, numbering in all 236 plants, were grown from the plant just described. All three families agreed in containing several types exhibiting a remarkable degree of variability.

An attempt was made to place the plants in five classes, but the categories overlapped and made classification for the most part impossible. The majority of the plants resembled the parent individual in their main features but they varied enormously in width of leaf from broad (21 mm.) to very narrow (8–6.5 mm.). These conditions were connected by intermediates, and, moreover, there were considerable variations within the individual, one branch with very narrow leaves being found on a plant with broad leaves. In addition to these variants, the three families contained 35 dwarfs, or 14.8 per cent, and the latter varied in leaf-width in the same remarkable manner. The dwarfs agreed only in having short internodes. Two of them are shown in pl. 21 figs. 13, 14, the former having narrow leaves and extremely short internodes, the leaves of the latter being quite linear. The plant would never be taken for an *cænothera*.

The advent of a large percentage of dwarfs in this family is similar to their occurrence in other *Æ. grandiflora* races from that locality (see Gates, '14, p. 246). The precise manner in which this capacity for producing dwarfs is inherited, is a difficult question which need not be considered here, particularly as it has been discussed elsewhere (Gates, '14).

Plate 22 fig. 15 represents one of the *Lamarckiana*-like rosettes from this source, grown in 1909. Others approached de Vries's race more closely, to the point of identity. Plate 22 figs. 18, 19 represent selected rosette-leaves taken from this culture to show the range of types exhibited. Such leaves as the

two on the right in pl. 22 fig. 18 were greatly overgrown and were far larger than ever appear even in *Œ. mut. gigas*. These forms have not been sufficiently studied since to give an adequate account of them.

It will be obvious that the forms described here under the names *multiflora*, *multiflora elliptica*, *rubrinervoides*, *tardiflora* and *rubritincta* are not pure species or even true-breeding races. They are undoubtedly as diverse from each other as average species, however, and many systematic species if bred experimentally would probably not breed true within narrower limits than these races have done. One feature of interest attaching to these races is the fact that the main type persists essentially unchanged, though various mutants and heterozygous forms are thrown off. The behavior is not, in the main, like the Mendelian process of recombination. Repeated selfing of each race usually decreases its variability by eliminating various hybrid elements. But this process does not extend to the basal differences between the races, which, as we have seen, remain as unlike as they were before. In this aspect the hereditary behavior of these races resembles that of *Œ. Lamarckiana*. But there are a number of differences which I need not fully consider. Thus *Œ. multiflora* gives rise to its variety *elliptica* much as though it were split off from a heterozygous condition, and the variability of *rubritincta* in leaf-width, as well as its production of numerous dwarfs, is unlike anything in the behavior of *Œ. Lamarckiana*.

Many other equally distinct types were derived from this locality (see, e. g., pl. 22 figs. 18, 19), but they have not been cultivated in subsequent generations.

Œ. LAMARCKIANA FROM ST. ANNE'S

In 1910 I obtained seeds from a colony of *Œ. Lamarckiana* growing by the Manchester Children's Hospital Convalescent Home, at St. Anne's-on-Sea. Many of these were found in later cultures to agree exactly with the *Lamarckiana* of de Vries except in the red color pattern of the sepals. I was formerly inclined to lay little stress on this difference but there is no doubt that it is inherited. The fact therefore remains that a precise duplicate for de Vries's race of *Œ. Lamarckiana* is relatively

infrequent on the Lancashire coast, although many forms approach it very closely and differ only in this one feature. As will be seen below, certain other plants agreed with de Vries's *Lamarckiana* except in the shape of the buds.

In 1911 a sowing of the seeds yielded 22 plants. The rosettes were for the most part uniform and very similar to *Æ. Lamarckiana*, two, however, having red midribs and lighter green leaves (*rubrinervis* type). One plant was aberrant, resembling *Æ. mut. semilata* in its buds, which were, however, small as in *Æ. biennis*. The bud cone was also somewhat rounded and barrel-shaped, length of ovary 11 mm., hypanthium 37 mm., cone 19 mm., petals 22 mm., style short so that anthers surround base of stigma. The features of this plant make it scarcely likely that it arose as a hybrid. It produced plenty of pollen and seeds.

Another sowing of these seeds in 1912 yielded 140 plants, which included one mut. *lata* with bad pollen (doubtless having 15 chromosomes) and one variegated *Lamarckiana* plant. The variegation was noticed when the plant was a young seedling. It reached maturity and proved to be a periclinal chimæra. Nearly all the leaves were variegated green and yellow. Many leaves were green bordered with yellow, showing the absence of chloroplasts from the epidermal and probably also the hypodermal layer. Occasional leaves were almost entirely yellow, and some were yellow on one side of the midrib and green on the other. There were also broad white bands on the margin of the sepals. The pollen was abundant and plenty of seeds were set.

Two sowings of seeds from this plant were made in 1912. The seeds numbered respectively 121 and 145. Only two seeds in one pan were observed to germinate, and the seedlings quickly died, probably from lack of chlorophyll. Regarding the origin of this periclinal mutation, it would appear to have originated in the embryo after fertilization through the loss of chloroplasts from the outer layers of the growing point.

The foliage in the rest of the culture agreed with the type of *Æ. Lamarckiana*. One plant differed in having stem-leaves more or less pointed at the base, not crinkled, midribs pink, and smaller flowers (petals 29 mm. long x 38 mm. broad, style short, buds

squarish). Two other plants agreed exactly with *Æ. Lamarckiana* except in the buds. The petals were 35 mm. long x 48 mm. broad, emarginate, anthers reaching nearly to top of stigma lobes, sepals green and with the same pubescence as in *Æ. Lamarckiana*, from which these two plants therefore differed only in the somewhat smaller flowers and shorter style. One mut. *nanella* also occurred in this culture, and several other slightly aberrant individuals, including a plant with broadly elliptical foliage. The "*Lamarckiana* foliage" was also more variable than in cultures from de Vries, this no doubt being due to the continued inbreeding in the latter case.

It will be understood that the new forms described here are scarcely to be looked upon as "new species" according to the usual interpretation at the present time. They merely represent a partial analysis of a complex interbreeding colony of forms, and their variability is one of their most interesting features. Nearly all if not all the differences observed are inherited, however, and the mutations can in many instances be separated from the characters arising through hybridization. The forms are, moreover, as distinct from each other as many species of *Ænothera*.

In conclusion, I am indebted to the Missouri Botanical Garden and the John Innes Horticultural Institution for the facilities provided for growing the plants, and to Mr. E. J. Allard for several of the photographs. A portion of the expenses of my second visit to Lancashire was defrayed by a grant from the Royal Society.

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EXPLANATION OF PLATE

PLATE 20

- Fig. 1. *œ. multiflora*, rosette, 1909.
- Fig. 2. *œ. multiflora elliptica*, rosette, 1911.
- Fig. 3. *œ. multiflora*, full-grown plant, 1909.
- Fig. 4. *œ. multiflora elliptica*, 1912.
- Fig. 5. *œ. multiflora*, 1912.
- Fig. 6. *œ. multiflora*, flowering shoot, 1909.
- Fig. 7. *œ. rubrinervoides*, young plantlet showing absence of rosette, 1909.

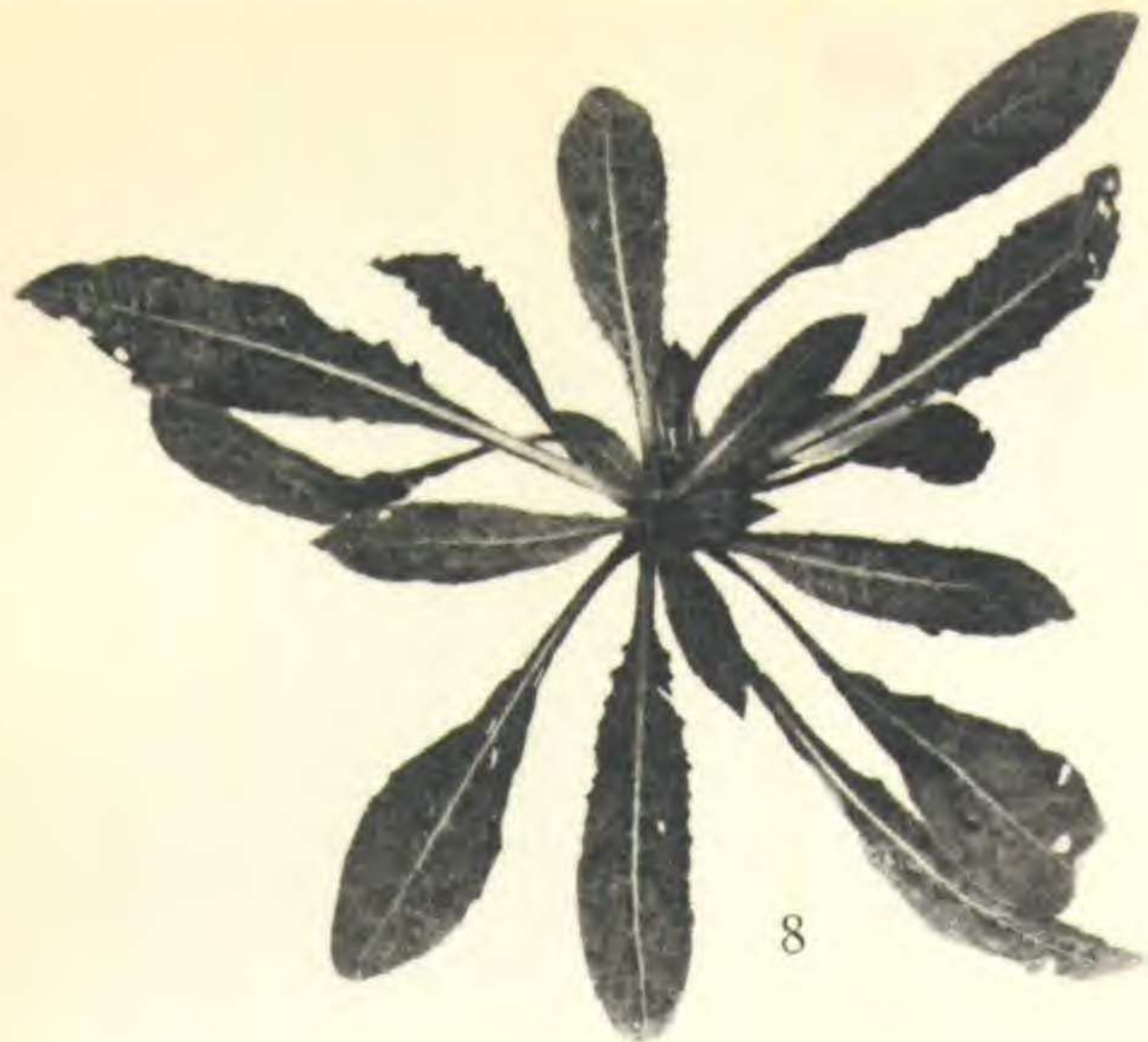


GATES—OENOTHERAS

EXPLANATION OF PLATE

PLATE 21

- Fig. 8. *Æ. rubrinervoides*, rosette, 1909.
Fig. 9. *Æ. rubrinervoides*, rosette, 1910.
Fig. 10. *Æ. rubrinervoides*, showing nearly smooth, pointed leaves, 1909.
Fig. 11. *Æ. rubrinervoides*, no rosette, 1909.
Fig. 12. *Æ. multiflora elliptica*, 1912. (Tip of plant drooped from wilting.)
Fig. 13. Linear-leaved dwarf in offspring of *Æ. rubritincta*, 1912.
Fig. 14. Dwarf offspring of *Æ. rubritincta*, 1912.



GATES—OENOTHERAS

EXPLANATION OF PLATE

PLATE 22

- Fig. 15. *Æ. Lamarckiana*-like rosette, 1909.
Fig. 16. *Æ. rubritincta*, 1911.
Fig. 17. *Æ. tardiflora*, showing serrated leaves and absence of flowers, August 21, 1909.
Fig. 18. Selected leaves from various rosettes, 1909.
Fig. 19. Selected leaves from various rosettes, 1909.
Fig. 20. *Æ. tardiflora*, showing late appearance of buds, October 2, 1909.